The study of sustainable energy at UB

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Abstract

Sustainable energy includes solar energy, wind energy, hydropower, geothermal energy, and biomass. It has environmental, health and cost advantages over fossil fuels. Therefore, it attracts more and more attention on the energy harvesting, conversion, and distributed storage. In this paper, the facility and current research topics in sustainable energy are presented. In the mean time, the energy-related courses are introduced for the training of the next generation of engineers.

Introduction

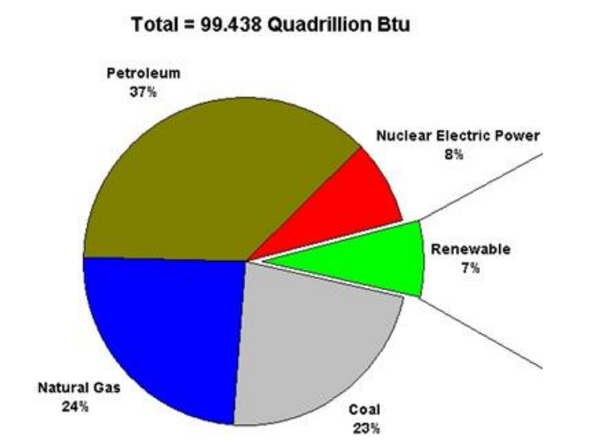

Figure 1. Energy Consumption in the Nation's Energy Supply, 2008

According to the U.S. Energy Information Administration's report, around 100 Quadrillion BTUs of energy was consumed in 2008 as shown in Figure 1. 37 % of the energy is from petroleum and 50% of the energy is from petroleum was imported around 9.67 million barrels/day.

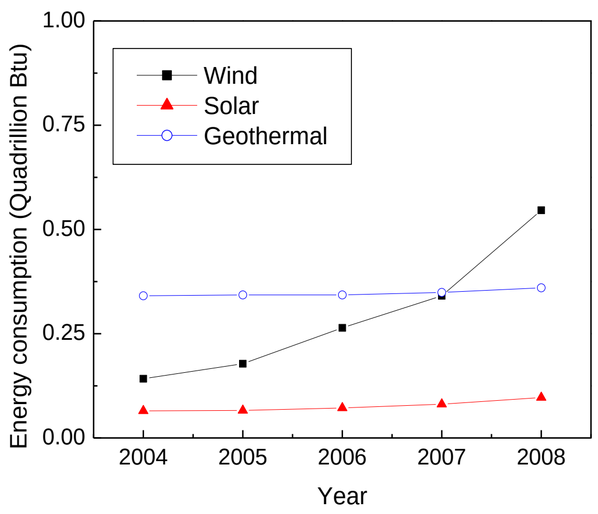

Figure 2. consumption of Sustainable energy from 2004 to 2008

Figure 2 shows the increase of the energy consumption sustainable energy resources including only solar, wind, and geothermal. At present, only 18 % of the total energy consumption is from sustainable resources

Figure 3 A smart grid power system

The power grid currently used to deliver electricity has not changed much in more than a century. It consists of 16,000 power plants, around 3,300 utilities, and 300,000 miles of power lines, with the problems as pollution, security, efficiency, and reliability. The Smart Grid is being considered as a viable solution to these problems and this new technology integrates sustainable energy resources and distributed energy storage sites. Figure 3 shows a general structure of a smart grid.

Facility and research

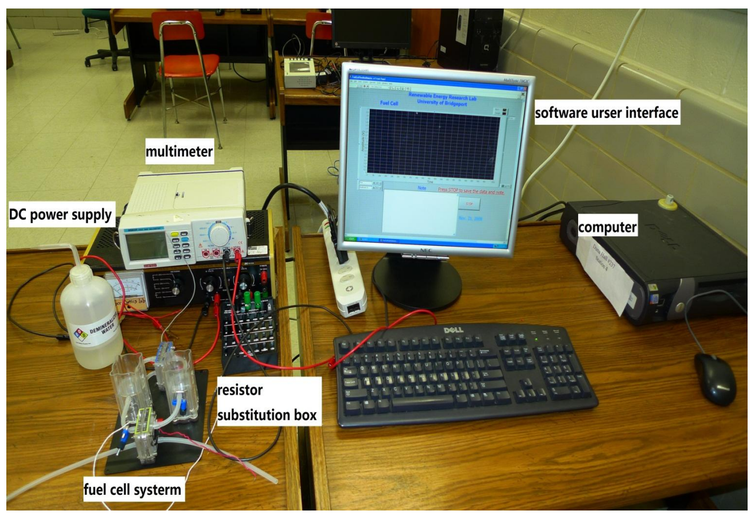

Figure 4. Setup for the VI measurement of a fuel cell

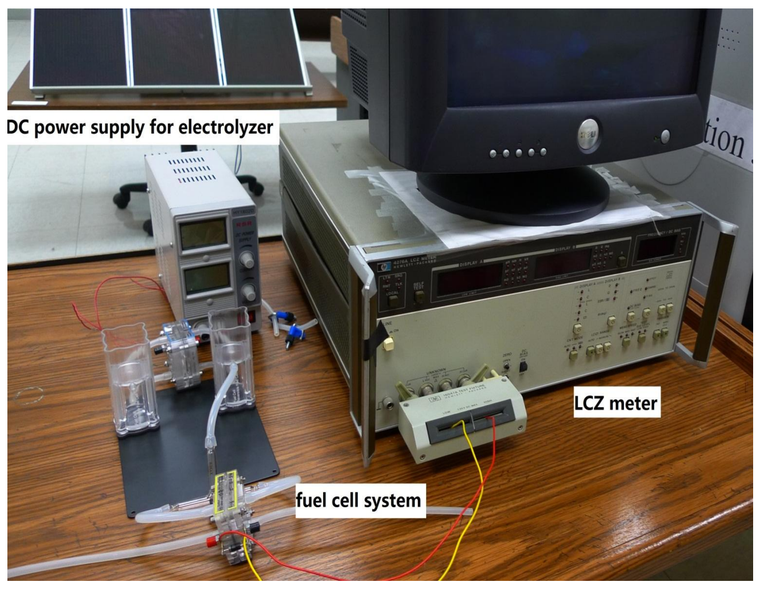

Figure 5. Setup for electrochemical spectra of a fuel cell

Figure 4 and 5 show the equipment used to characterize a hydrogen PEM fuel cell or a fuel cell stack. At present, the operating temperature and the total operating pressure are constant.

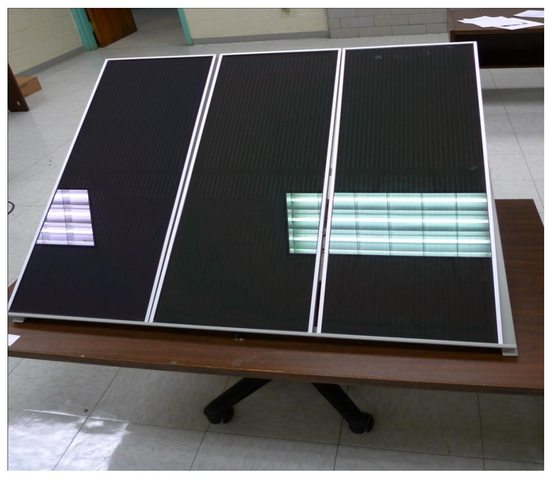

Figure 6 45 watts solar panel

Figure 7 1 kW wind turbine

Figure 6 and 7 are the solar panel and wind turbine in the lab. In addition, there are charge controller, converter, pure sine wave inverter, and power electronics board for study and research.

List of software:

- LabVIEW
- ETAP
- SCAPS

List of research topics:

- Characterization and simulation of hydrogen fuel cell
- Characterization and design of solar cell
- Control and optimization of solar and wind hybrid power system
- Design and implementation of hybrid laboratory
- Optimization of smart grid

Energy-related courses

Sustainable Energy
Sustainable Energy Laboratory
Solar Energy and Solar Cells
Fuel Cells
Power Electronics

Conclusions

The facility and the research capability are introduced. In the near future, there will be a new MS program as Sustainable Energy Engineering.